

University of Manitoba**Pavement Research Group**

Hydraulic Conductivity Test Summary

Sample ID	UGM-1(12.3)	Project	MI Drainable Base
Replicate #	1	Sampled by	Manitoba Infrastructure
Date Tested	10 /1/2018	Soil Type	Gravel with 12 fines
Sample Dry Density (Kg/m3)	2115	Max. Dry Density (Kg/m3)	2156
Sample Moisture (%)	8.9%	Optimum Moisture (%)	8.7%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt ^{*K})
80340	0.401	6	2.676E-09	31	2.080E-09

Tested By	Amin Mneina	K	2.080E-09
Reviewd By	Dr. Ahmed Shalaby		

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Hydraulic Conductivity Test Summary

Sample ID	UGM-1(12.3)	Project	MI Drainable Base
Replicate #	2	Sampled by	Manitoba Infrastructure
Date Tested	10 /1/2018	Soil Type	Gravel with 12 fines
Sample Dry Density (Kg/m3)	2100	Max. Dry Density (Kg/m3)	2156
Sample Moisture (%)	10.5%	Optimum Moisture (%)	8.7%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt ^{*K})
81480	0.401	1	4.398E-10	31	3.417E-10

Tested By	Amin Mneina	K	3.417E-10
Reviewd By	Dr. Ahmed Shalaby		

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Hydraulic Conductivity Test Summary

Sample ID	UGM-1(9.7)	Project	Design Parameters and Specifications of UGM
Replicate #	3	Sampled by	Yukon Department of Highways and Public Works
Date Tested	22/11/2017	Soil Type	Gravel with 9.7 fines
Sample Dry Density (Kg/m3)	2253	Max. Dry Density (Kg/m3)	2362
Sample Moisture (%)	5.6	Optimum Moisture (%)	6.4%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
1800	0.404	10	1.97612E-07	27.2	1.67971E-07
1800	0.404	10	1.97612E-07	28	1.64413E-07
1800	0.404	10	1.97612E-07	28.6	1.62042E-07
1800	0.404	10	1.97612E-07	29	1.5809E-07
1800	0.404	8	1.5809E-07	29.5	1.25563E-07

Tested By	Amin Mneina	K 1.55616E-07
Reviewd By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-2(3.5)	Project	Design Parameters and Specifications of UGM
Replicate #	1	Sampled by	Yukon Department of Highways and Public Works
Date Tested	29/8/2017	Soil Type	Gravel with 3.5 fines
Sample Dry Density	2153	Max. Dry Density (Kg/m3)	2206
Sample Moisture (%)	9.45	Optimum Moisture (%)	9%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperatre (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
1800	0.375	110	2.33379E-06	31	1.81336E-06
1800	0.375	108	2.29136E-06	31	1.78039E-06
4200	0.375	240	2.18225E-06	31	1.6956E-06
2700	0.375	146	2.06505E-06	31	1.60454E-06
2100	0.375	124	2.25499E-06	31	1.75213E-06
1800	0.375	106	2.24893E-06	31	1.74742E-06

Tested By	Amin Mneina	K 1.73224E-06
Reviewd By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-2(3.5)	Project	Design Parameters and Specifications of UGM
Replicate #	2	Sampled by	Yukon Department of Highways and Public Works
Date Tested	28/8/2017	Soil Type	Gravel with 3.5 fines
Sample Dry Density	2132	Max. Dry Density (Kg/m3)	2206
Sample Moisture (%)	8.78	Optimum Moisture (%)	9%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperatre (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
900	0.399	54	2.15353E-06	35.6	1.67329E-06
900	0.399	54	2.15353E-06	35.1	1.67329E-06
900	0.399	56	2.23329E-06	34.4	1.73527E-06
900	0.399	58	2.31305E-06	34	1.79724E-06
450	0.399	32	2.55233E-06	33.8	1.98316E-06
450	0.399	30	2.39281E-06	33.6	1.85922E-06

Tested By	Amin Mneina	K 1.78691E-06
Reviewd By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-2(4.9)	Project	Design Parameters and Specifications of UGM
Replicate #	3	Sampled by	Yukon Department of Highways and Public Works
Date Tested	29/8/2017	Soil Type	Gravel with 4.9 fines
Sample Dry Density	2165	Max. Dry Density (Kg/m3)	2237
Sample Moisture (%)	7.3	Optimum Moisture (%)	8.6%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
900	0.399	24	9.61613E-07	27.8	8.00062E-07
900	0.399	25	1.00168E-06	28.1	8.33398E-07
1020	0.399	27	9.54542E-07	28.7	7.63634E-07
600	0.399	23	1.38232E-06	29.1	1.10585E-06
600	0.399	23	1.38232E-06	29.4	1.09791E-06
3000	0.399	76	9.13532E-07	29.5	7.25573E-07

Tested By	Amin Mneina	K 8.87738E-07
Reviewd By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-2(4.9)	Project	Design Parameters and Specifications of UGM
Replicate #	4	Sampled by	Yukon Department of Highways and Public Works
Date Tested	29/8/2017	Soil Type	Gravel with 4.9 fines
Sample Dry Density	2281	Max. Dry Density (Kg/m3)	2237
Sample Moisture (%)	10.0	Optimum Moisture (%)	8.6%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperatre (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
1800	0.399	36	7.2121E-07	32	5.6038E-07
1800	0.399	39	7.81311E-07	31.8	6.07078E-07
1800	0.399	39	7.81311E-07	31.7	6.07078E-07
1800	0.399	38	7.61277E-07	31.6	5.91512E-07

Tested By	Amin Mneina	K 5.91512E-07
Reviewd By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-2(6.4)	Project	Design Parameters and Specifications of UGM
Replicate #	4	Sampled by	Yukon Department of Highways and Public Works
Date Tested	1/9/2017	Soil Type	Gravel with 6.4 fines
Sample Dry Density	2192	Max. Dry Density (Kg/m ³)	2287
Sample Moisture (%)	8.4	Optimum Moisture (%)	8.5%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt ² *K)
1200	0.399	6	1.79461E-07	30.4	1.40473E-07
1200	0.399	6	1.79461E-07	30.7	1.40473E-07
1200	0.399	5	1.49551E-07	30.9	1.16201E-07
1200	0.399	5	1.49551E-07	31.1	1.16201E-07
1200	0.399	6	1.79461E-07	31.2	1.39441E-07

Tested By	Amin Mneina	K 1.30558E-07
Reviewed By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-2(6.4)	Project	Design Parameters and Specifications of UGM
Replicate #	3	Sampled by	Yukon Department of Highways and Public Works
Date Tested	1/9/2017	Soil Type	Gravel with 6.4 fines
Sample Dry Density	2137	Max. Dry Density (Kg/m ³)	2287
Sample Moisture (%)	8.2	Optimum Moisture (%)	8.5%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt ³ *K)
2160	0.375	8	1.41442E-07	26.8	1.20226E-07
4800	0.375	20	1.59122E-07	27.4	1.33822E-07
1800	0.375	7	1.48514E-07	28	1.23564E-07
1800	0.375	7	1.48514E-07	28.3	1.23564E-07
1800	0.375	7	1.48514E-07	28.4	1.23564E-07
1800	0.375	7	1.48514E-07	28.6	1.21781E-07

Tested By	Amin Mneina	K
Reviewd By	Dr. Ahmed Shalaby	1.40473E-07

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Hydraulic Conductivity Test Summary

Sample ID	UGM-3(3.9)	Project	Design Parameters and Specifications of UGM
Replicate #	3	Sampled by	Yukon Department of Highways and Public Works
Date Tested	25/8/2017	Soil Type	Gravel with 3.9 fines
Sample Dry Density	2191	Max. Dry Density (Kg/m ³)	2221
Sample Moisture (%)	9.82	Optimum Moisture (%)	9%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperatre (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt*K)
900	0.375	40	1.6973E-06	26.8	1.44271E-06
690	0.375	30	1.6604E-06	25.5	1.4595E-06
690	0.375	32	1.7711E-06	24.2	1.6117E-06
1800	0.375	62	1.31541E-06	23.1	1.22465E-06
690	0.375	28	1.54971E-06	23	1.44278E-06
690	0.375	34	1.88179E-06	22.5	1.77265E-06

Tested By	Amin Mneina	K 1.49233E-06
Review By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-3(3.9)	Project	Design Parameters and Specifications of UGM
Replicate #	4	Sampled by	Yukon Department of Highways and Public Works
Date Tested	26/8/2017	Soil Type	Gravel with 3.9 fines
Sample Dry Density	2190	Max. Dry Density (Kg/m3)	2221
Sample Moisture (%)	8.30	Optimum Moisture (%)	9%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
510	0.399	24	1.69487E-06	31.2	1.31691E-06
510	0.399	23	1.62425E-06	31.3	1.26204E-06
2700	0.399	126	1.68075E-06	31.3	1.30594E-06
900	0.399	43	1.72076E-06	31.6	1.33703E-06
900	0.399	43	1.72076E-06	31.6	1.33703E-06
900	0.399	42	1.68075E-06	31.6	1.30594E-06

Tested By	Amin Mneina	K 1.31082E-06
Reviewed By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-3(6.9)	Project	MI Drainable Base
Replicate #	1	Sampled by	Manitoba Infrastructure
Date Tested	16-2-2018	Soil Type	Gravel with 6.9% fines
Sample Dry Density (Kg/m3)	1971	Max. Dry Density (Kg/m3)	2053
Sample Moisture (%)	9.0%	Optimum Moisture (%)	10.1%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt ^K)
1800	0.404	10	1.575E-08	27.2	3.560E-07
Tested By Amin Mneina					K 3.560E-07
Reviewd By Dr. Ahmed Shalaby					

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Hydraulic Conductivity Test Summary

Sample ID	UGM-3(6.9)	Project	MI Drainable Base
Replicate #	2	Sampled by	Manitoba Infrastructure
Date Tested	22/2/2018	Soil Type	Gravel with 6.9% fines
Sample Dry Density (Kg/m3)	1927	Max. Dry Density (Kg/m3)	2053
Sample Moisture (%)	9.2%	Optimum Moisture (%)	10.1%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt ^K)
1200	0.395	32	9.70152E-07	23.3	2.53237E-06
600	0.395	16	9.70152E-07	23.5	2.15735E-06
600	0.395	16	9.70152E-07	23.6	2.08433E-06
600	0.395	16	9.70152E-07	23.7	2.02817E-06

Tested By	Amin Mneina	K 2.201E-06
Reviewed By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-3(7.1)	Project	MI Drainable Base
Replicate #	1	Sampled by	Manitoba Infrastructure
Date Tested	5/2/2018	Soil Type	Limestone with 7.1% fines
Sample Dry Density (Kg/m3)	2091	Max. Dry Density (Kg/m3)	2226
Sample Moisture (%)	6.5%	Optimum Moisture (%)	6.9%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
195	0.401	20	3.67552E-06	29.4	5.31105E-06
300	0.401	20	2.38909E-06	29.4	5.47078E-06
410	0.401	20	1.74811E-06	29.4	4.85076E-06
525	0.401	20	1.36519E-06	29.4	4.99224E-06
645	0.401	20	1.1112E-06	29.5	5.09846E-06

Tested By	Amin Mneina	K
Reviewd By	Dr. Ahmed Shalaby	5.1E-06

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Hydraulic Conductivity Test Summary

Sample ID	UGM-3(7.1)	Project	MI Drainable Base
Replicate #	2	Sampled by	Manitoba Infrastructure
Date Tested	21/2/2018	Soil Type	Limestone with 7.1% fines
Sample Dry Density (Kg/m3)	2176	Max. Dry Density (Kg/m3)	2226
Sample Moisture (%)	6.5%	Optimum Moisture (%)	6.9%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
205	0.395	20	3.54934E-06	24.5	3.19263E-06
254	0.395	20	2.86462E-06	23.4	2.63688E-06
246	0.395	20	2.95778E-06	23.1	2.75369E-06
255	0.395	20	2.85339E-06	23.3	2.62654E-06
253	0.395	20	2.87594E-06	23.3	2.64731E-06

Tested By	Amin Mneina	K 2.8E-06
Reviewd By	Dr. Ahmed Shalaby	

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Hydraulic Conductivity Test Summary

Sample ID	UGM-4(3.3)	Project	MI Drainable Base
Replicate #	1	Sampled by	Manitoba Infrastructure
Date Tested	25/1/2018	Soil Type	Gravel with 3.3% fines
Sample Dry Density (Kg/m3)	2119	Max. Dry Density (Kg/m3)	2220
Sample Moisture (%)	7.4%	Optimum Moisture (%)	7.8%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
195	0.401	20	3.67552E-06	25.4	3.23078E-06
300	0.401	10	1.19454E-06	25.4	3.00001E-06
410	0.401	10	8.74057E-07	25.4	2.86365E-06
525	0.401	10	6.82597E-07	25.4	2.73914E-06
645	0.401	10	5.55602E-07	25.5	2.62501E-06

Tested By Amin Mneina
Reviewd By Dr. Ahmed Shalaby

K 2.9E-06

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Hydraulic Conductivity Test Summary

Sample ID	UGM-4(3.3)	Project	MI Drainable Base
Replicate #	2	Sampled by	Manitoba Infrastructure
Date Tested	29/1/2018	Soil Type	Gravel with 3.3% fines
Sample Dry Density (Kg/m3)	2102	Max. Dry Density (Kg/m3)	2220
Sample Moisture (%)	8.0%	Optimum Moisture (%)	7.8%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K20=Rt*K)
195	0.401	20	3.67552E-06	29.4	1.39126E-06
300	0.401	10	1.19454E-06	29.4	1.29757E-06
410	0.401	10	8.74057E-07	29.4	1.34948E-06
525	0.401	10	6.82597E-07	29.4	1.34948E-06

Tested By Amin Mneina
Reviewd By Dr. Ahmed Shalaby

K 1.3E-06

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Hydraulic Conductivity Test Summary

Sample ID	UGM-4(7.8)	Project	MI Drainable Base
Replicate #	1	Sampled by	Manitoba Infrastructure
Date Tested	6/7/2018	Soil Type	Limestone with 7.8 fines
Sample Dry Density	1953	Max. Dry Density (Kg/m ³)	2065
Sample Moisture	5.8%	Optimum Moisture (%)	6.8%

Test Readings

Time (S)	Hydraulic Head (m)	Outflow Volume (mL)	Hydraulic Conductivity (m/s)	Water Temperature (C)	Corrected Hydraulic Conductivity (K ₂₀ =Rt*K)
205	0.393	20	3.5674E-06	22.8	3.32125E-06
196	0.393	20	3.73121E-06	22.4	3.5148E-06
199	0.393	20	3.67496E-06	22.3	3.46181E-06
199	0.393	20	3.67496E-06	22.5	3.46181E-06

Tested By	Amin Mneina	K
Reviewd By	Dr. Ahmed Shalaby	3.4E-06